A Computer Mouse

Technical Field

The present utility model relates to a computer external device, and more particularly, to a computer mouse.

Background Art

Since computer mouse came into being at the end of 1968, the following four generations, which are divided from a technical view point, have been developed,

(1) Mechanical mouse:

The operation principle of the mechanical mouse lies in the use of the rotary ball at the bottom of the mouse, i.e. when the rotary ball physically contacts the surface of the table and rotates to different directions, it drives the pressure rotary shafts in different directions to rotate. These rotary shafts are connected to a circular coder on which contacts are arranged in a circle. The rotation of the rotary ball is transferred through pressure shafts to enable the contacts to be in contact with contact strips so as to produce on-off signals which are further transformed into 0-1 signals. These data are further transformed into two-dimensional X-Y axes displacement signals by means of a special chip to guide the cursor to move accordingly. Because this type of mouse is of a purely mechanical structure, it has the inherited disadvantages of low precision and vulnerability, and it is now hardly found on the market.

(2) Optical-mechanical mouse:

The mechanical mouse is substituted by the optical-mechanical mouse. This type of mouse is of a similar structure of the mechanical mouse. The only difference between them is that a different coder is used to detect the movements of the mouse. The coder used in the optical-mechanical mouse consists of a disc with a plurality of narrow slits, and photo tubes and light-emitting diodes disposed on both sides thereof. The movement of the disc caused by the rotation of the rotary ball sends on-off signals produced by the cutting off of the light path to the photo tubes, and the microprocessor inside the mouse will then calculate the distance and direction of the movement of the mouse based on these signals and the skewing thereof. Since the kernel positioning mechanism of this type of mouse consists of photo components,

it is characterized by a longer service life (as compared with the purely-mechanical mouse) and higher positioning precision. However, as the basic positioning mechanism of this type of mouse is still the mechanical rotary ball, just like the conventional mechanical mouse, it will cause the cursor to move slowly or jump resulting in wrong positioning. This is mainly due to the dust attached on the inside rotary shafts. It is necessary to clean it thoroughly before it can be used properly again.

(3) Photo mouse of the first generation:

Photo mouse is particularly superior in positioning precision, service life and operation hand-feeling because the positioning system of mechanical structure is not used therein any more.

The photo mouse of the first generation is used with a special mouse pad having a reflecting surface and very regular grid lines formed by black lines and blue lines. Two light-emitting diodes are arranged at the bottom of the mouse, with one emitting red light absorbable by blue lines and the other emitting infrared light absorbable by black lines. At the bottom of the mouse, there is also arranged another group of photo tubes used to receive the reflected lights. The photo mouse determines the direction and distance of the mouse on the basis of the signals reflected after the two groups of lights illuminate the X, Y axes on the mouse pad. As this type of photo mouse has to be operated on a special mouse pad which needs to be always clean, it is not convenient to use the mouse. Therefore, it has not been popularized widely.

(4) Photo mouse of the second generation:

The photo mouse of the second generation is developed by Agilent Technologies Co., Ltd. USA. In said mouse, light-emitting diodes are used to illuminate the surface of an object; snapshots are made at predetermined intervals; and then properties of two pictures are analyzed and processed to detect the moving direction and value of the coordinates.

In order to determine the displacement of the mouse, it is necessary to scan the pictures, therefore scanning frequency becomes an important parameter for assessing the photo mouse. Generally, as a minimum requirement, a scanning frequency of 1,500 times per second is required. The scanning frequency of some of the products made by Microsoft Corporation has reached 6,000 times per second. Another parameter that should not be neglected is the

resolution power of the mouse. This parameter is indicated by count per inch (cpi). Generally, the resolution power of the mouse is 400 cpi, i.e. coordinates values are transmitted for 400 times for every movement of 1 inch (while at present, the resolution power of photo mouse of better quality may reach 800 cpi).

As mentioned above, the purely-mechanical mouse has already been eliminated; the optical-mechanical mouse has disadvantages which are difficult to overcome, such as low positioning precision, unsmooth operation hand-feeling and function deterioration after long use; the photo mouse of the first generation has not been popularized widely because of the high requirements for use; nevertheless the photo mouse of the second generation has overcome the disadvantage of inconvenience in use of the photo mouse of the first generation, and is characterized by its high precision and long service life, therefore has occupied a place in the high-end products market. However, due to the complicated principle and structure, its cost remains high, and due to the limitation of the technological and cost factors, its reacting speed is not sufficient.

Contents of the Utility Model

The object of the present utility model is to provide a computer mouse, so as to solve the problems of inconvenience in use, complexity of technology and high cost of the prior art.

The technical scheme of the present utility model is: the computer mouse comprises a mouse body; inside the mouse body, an amplifying and shaping module, a direction identifying and counting module, and a computer interface circuit for processing photoelectric signals are disposed and connected in sequence, characterized in that, said computer mouse further includes at least one laser device and a photo sensor for receiving laser speckle signals from the object surface illuminated by laser beams; said photo sensor transfers the received photoelectric signals to the amplifying and shaping module.

A focusing lens is further installed in the light path of the photo sensor for receiving laser speckle signals;

A collimating lens is further installed in the light path of the laser device for emitting laser beams;

A diaphragm with light apertures is further installed in the light path of the laser device

for emitting laser beams;

A pupil with light apertures is further installed in the light path of the focusing lens for receiving laser speckle signals;

Said pupil is located in the front of the focusing lens;

Said pupil is located in the rear of the focusing lens;

Said pupil has at least 3 light apertures, the centers of said light apertures are not aligned in the same line;

The laser beams of said laser device pass the spectroscope, so as to form multiple laser beams irradiating on the surface of the object;

Said split laser beams converge on the surface of the object after being reflected by the reflector (9).

The principle and beneficial effect of the present utility model are: when a beam of laser illuminates a rough surface of an object, the illuminated area does not become bright continuously. On the contrary, there are many disorderly alternating bright spots and dark spots. This phenomenon is called speckles. As shown in Fig. 1, the speckles exist not only on the rough surface of an object, but also in the entire space in the vicinity of the rough surface of an object illuminated by laser.

The laser speckle is actually a kind of interference phenomenon caused by the construction and destruction between the scattered light waves on each area unit of the rough surface of an object, which can be explained and the general features of which can be derived with the theory of laser interference.

Theoretical study shows that, if the incidence angle of laser is fixed, the contrast ratio of the speckles is related to the roughness of the surface of the illuminated object. Many objects used in daily life can easily meet the requirements of roughness for forming speckles. Experiments have proved that the phenomenon of speckles can be obviously observed when laser beam illuminates on most ordinary objects, such as table surface, paper, textile, common metal, plastics, pottery and ceramics surfaces, and glass. The laser speckles may be considered dependent on the illuminated surface of the object, therefore they move along with the movement of the object. The relative displacement between the object and the observer (device) can be measured on the basis of this feature of the speckles.

In the present utility model, according to the features of the speckles, speckle signals are received by photo sensors, and then simply processed by direction identifying and counting to determine the displacement vector. This purely photo technology overcomes all the disadvantages of the mechanical device. It has a simple structure, high technical feasibility, high precision, and may greatly increase the precision and speed of measurement with economic methods.

Description of the Drawings

Fig. 1 is a schematic view of laser speckles;

Fig. 2 is a schematic view showing the principle of the present utility model;

Fig. 3 is a schematic view showing the principle of the present utility model;

Fig. 4 is a schematic view showing the principle of the present utility model;

Fig. 5 is a schematic view of the embodiment 1;

Fig. 6 is a schematic view showing the principle of the circuits of the present utility model;

Fig. 7 is a schematic view of the embodiment 2;

Fig. 8 is a schematic view of the embodiment 3;

Fig. 9 is a schematic view of the embodiment 4.

Embodiments

Hereinafter, the present utility model will be described in details with reference to the accompanying drawings and embodiments.

The size of the laser speckle, i.e., the statistical average value of distances between the adjacent brightest point and darkest point, is related to the wave length of laser and to the aperture angle of the radiation producing the speckles with respect to the plane determining the speckle field. As shown in Fig. 2, the size σ of the speckle formed on the screen AB at a distance of L, which is also called "objective speckle", by laser scatter from the circular area of a diameter D, may be expressed approximately by the following formula 1:

$$\sigma \approx 1.2 \lambda L/D$$

As shown in Fig. 3, if the radiation field of the scatter is focused onto a screen by a lens,

a "subjective speckle" will be formed. Under such circumstances, the relationship between the size σ of the individual speckle and the effective numerical aperture N.A. of the lens may be expressed by the following formula 2:

$\sigma \approx 0.6\lambda / \mathrm{N.A.}$

Although the size of the speckles follows the statistical rules of the above formula 1or 2, the size of each specific speckle is random, therefore, accurate measurement data cannot be obtained from simple counting of the pulses outputted and shaped by the photo sensing components. However, since the size of the speckles follows the statistical rules, the sum (or average value) of the size of a plurality of speckles (obtainable by adding a plurality of pulses together or averaging them) can relatively accurately conform with the statistical average size. Moreover, under typical application conditions, speckles are very small, ranging generally from several hundred nanometers to several micrometers, therefore the integrated precision reflected by the sum (or average value) of the size of a plurality of speckles is much higher than the precision (approximately between 30 and 100 micrometers) required by mouse of the prior art. Hence, the sum (or average value) of a plurality of speckle pulses may be used to determine the displacement value of a mouse device.

In the meantime, if two beams of laser are used to illuminate the object at the same angle, more precise measurement results may be obtained at one dimension. As shown in Fig. 4, if the displacement in the direction of the surface of the illuminated object is d, then we have formula 3:

$d = n\lambda /2 \sin\theta$, where n is the quantity of pulses of laser speckles.

If displacement within two-dimensional plane is to be measured according to the principle of formula 3, at least three laser beams are needed and all of the three laser beams shall not be in the same plane.

As mentioned above, various structural forms of single beam, double (multiple) beams may be used in laser speckle measurement for measuring the displacement within a plane. These forms will be discussed respectively hereinafter.

Embodiment 1:

In Fig. 5 and Fig. 6, the device according to the present utility model includes a mouse body, and as shown in Fig. 5 and Fig. 6, inside the mouse body, an amplifying and shaping

module 1, a direction identifying and counting module 2, and a computer interface circuit 3 are disposed and connected in sequence, and the device further includes a laser device 4 and a photo sensor 5 for receiving laser speckle signals from the object surface illuminated by laser beams. Said photo sensor 5 transfers the received photoelectric signals to the amplifying and shaping module 1.

As shown in Fig. 6, after laser speckle signals from the object surface illuminated by laser beams are received by the photo sensor 5, relevant photoelectric signals are transferred to the amplifying and shaping module 1 for processing, and then they are processed by the direction identifying and counting module 2 to calculate the displacement on the illuminated surface of the object (with respect to the computer mouse). At the same time, in the direction identifying and the counting module 2, at least two photo sensor units included in one group in the photo sensor 5 are used. When speckles passing the (at least) two units, they produce electric signals with a phase difference Φ. With this phase difference (i.e. the sequence of the two signals) we can determine the displacement component in the direction of the alignment of the units in this group. Therefore we can use two groups of photo sensor units in different directions to determine the moving direction of the speckles in the whole two-dimensional plane, so as to obtain the moving direction of the computer mouse. We usually use two orthogonal groups of units in practice. The signals processed by the direction identifying and counting module 2 are transferred to the computer interface circuit 3, which may use the interface and processing circuit module of the ordinary mouse, for sending out control signals to the computer.

Embodiment 2:

As shown in Fig. 7 and with reference to Fig. 6, the difference between the present embodiment and embodiment 1 is that, in the present embodiment, a focusing lens 6 is arranged in the light path for receiving laser speckle signals in the photo sensor 5. As the structure, principle and operation method are the same as those of the embodiment 1, unnecessary details will not be given here.

Embodiment 3:

As shown in Fig. 8 and with reference to Fig. 6, the difference between the present embodiment and embodiment 2 is that, the pupil 7 has at least three light apertures 71

arranged in front of or behind the focusing lens 6. The centers of the light apertures 71 are not in a line. Since the centers of the light apertures 71 are not in a line, two-dimensional sampling of photoelectric signals of displacement may be conducted. Fig. 8 shows only two light apertures in one dimension, and the light aperture in the other dimension which is not shown is similar in structure. In the present embodiment, a structural form of double (multiple) beams is used, whereas both in embodiment 1 and embodiment 2, the structural form of single beam is used. The structural form of double (multiple) beams helps to enhance the coherence of the light source, improve the reliability and precision of detection. As the structure of other parts and the principle and operation method of the present embodiment are the same as those of embodiment 1 and embodiment 2, unnecessary details will not be given here.

Embodiment 4:

As shown in Fig. 9 and with reference to Fig. 6, in the present embodiment, laser device 4 forms two laser beams through a spectroscope 8. The split laser beams converge on the object surface after being reflected by the speculum 9. Fig. 9 shows the spectroscope 8 and speculum 9 in the light path in one-dimensional direction. One or two of the above-mentioned two laser beams may further be split by the spectroscope 8 into three or four laser beams to illuminate the object surface. Thus, two-dimensional sampling of photoelectric signals of displacement is realized by splitting the laser beam by the spectroscope 8 into multiple laser beams to illuminate the object surface. In the present embodiment, the structural form of double (multiple) beams is also used. As the structure of other parts and the principle and operation method of the present embodiment are the same as those of the above-mentioned embodiments, unnecessary details will not be given here.

In each of the embodiments, a collimation lens 10 may also be arranged in the emission path of the laser device 4. As shown in Fig. 9, the main object of arranging a collimation lens 10 is to reduce the illuminated area of the object surface so as to facilitate measuring. A diaphragm having light apertures may also be arranged in the emission path of the laser device 4. The main function, method of usage of the diaphragm is similar to those of the collimation lens 10, therefore unnecessary details will not be given here.

In the present utility model, as long as coherence is ensured, two or more laser devices 4 may be used. As the principle and method of usage are the same as the above, unnecessary

details will not be given here.

What is claimed is:

1. A computer mouse consisting of a mouse body; inside the mouse body, an amplifying and shaping module (1), a direction identifying and counting module (2) and a computer interface circuit (3) for processing photoelectric signals are disposed and connected in sequence, characterized in that, said device further includes at least one laser device (4) and a photo sensor (5) for receiving laser speckle signals from the object surface illuminated by laser beams; said photo sensor (5) transfers the received photoelectric signals to the amplifying and shaping module (1).

2. A computer mouse as claimed in claim 1, characterized in that, a focusing lens (6) is further installed in the light path of the photo sensor (5) for receiving laser speckle signals.

3. A computer mouse as claimed in claim 1, characterized in that, a collimating lens (10) is further installed in the light path of the laser device (4) for emitting laser beams.

4. A computer mouse as claimed in claim 1, characterized in that, a diaphragm with light apertures is further installed in the light path of the laser device (4) for emitting laser beams.

5. A computer mouse as claimed in claim 2, characterized in that, a pupil (7) with light apertures (71) is further installed in the light path of the focusing lens (6) for receiving laser speckle signals.

6. A computer mouse as claimed in claim 5, characterized in that, said pupil (7) is located in the front of the focusing lens (6).

7. A computer mouse as claimed in claim 5, characterized in that, said pupil (7) is located in the rear of the focusing lens (6).

8. A computer mouse as claimed in claim 5 or 6 or 7, characterized in that, said pupil (7) has at least 3 light apertures (71), the centers of said light apertures (71) are not aligned in the same line.

9. A computer mouse as claimed in claim 1, characterized in that, the laser beams of the laser device (4) pass the spectroscope (8), so as to form multiple laser beams irradiating on the

surface of the object.

10. A computer mouse as claimed in claim 9, characterized in that, the split laser beams converge on the surface of the object after being reflected by the reflector (9).

Abstract

The present utility model relates to a computer mouse of the computer external device, comprising a mouse body, inside the mouse body, an amplifying and shaping module, a direction identifying and counting module and a computer interface circuit for processing photoelectric signals are disposed and connected in sequence, characterized in that, said device further includes at least one laser device and a photo sensor for receiving laser speckle signals from the object surface illuminated by laser beams, said photo sensor transfers the received photoelectric signals to the amplifying and shaping module; a focusing lens may be further installed in the light path of the photo sensor for receiving laser speckle signals; a pupil with at least 3 light apertures may be further installed in the front or in the rear of the focusing lens; a collimating lens or a diaphragm may be further installed in the light path of the laser device for emitting laser beams, said laser beams of the laser device may pass the spectroscope, so as to form multiple laser beams irradiating on the surface of the object. The present utility model has a simple structure, high technical feasibility and high precision.

(Fig. 5 for Abstract)

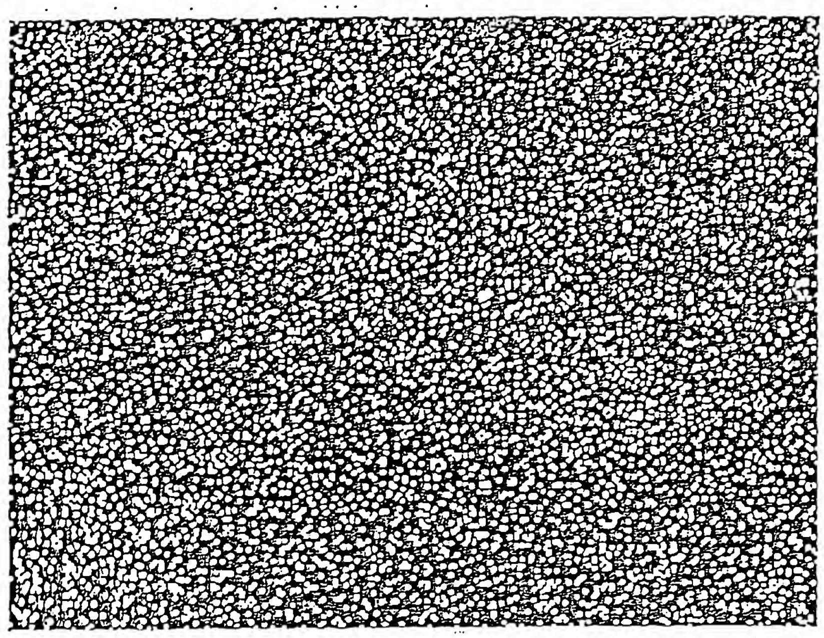

Fig. 1

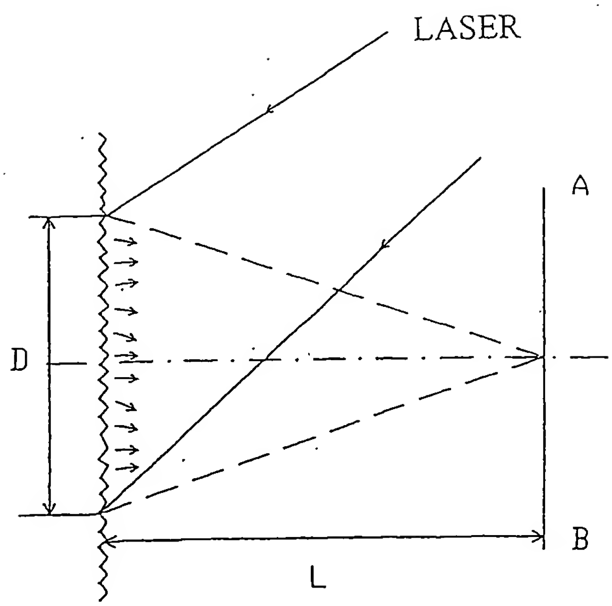

Fig. 2

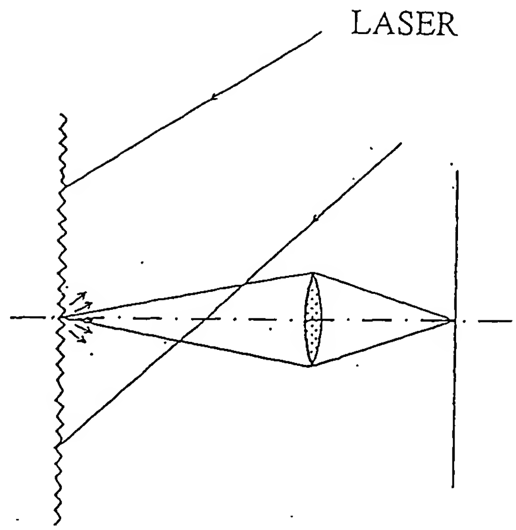

Fig. 3

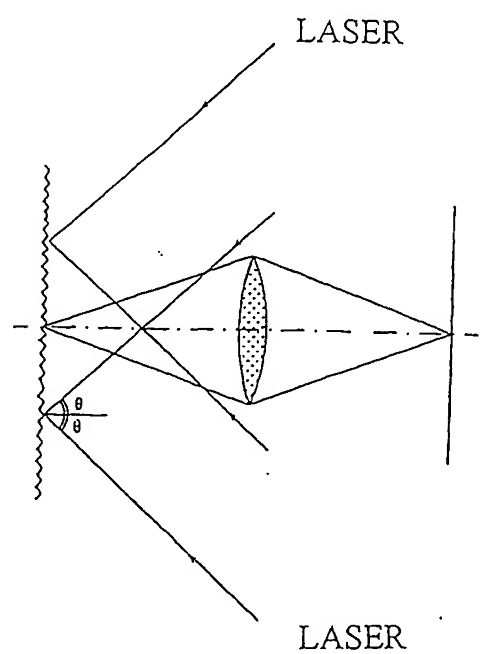

Fig. 4

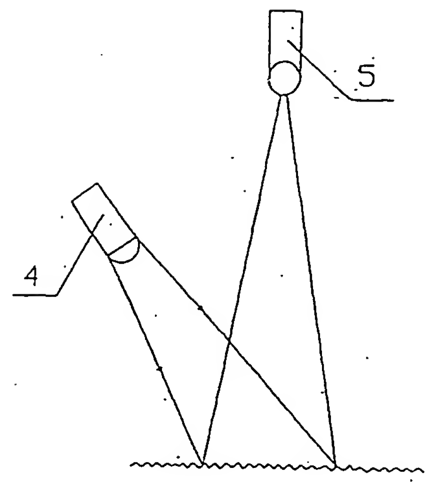
5
4

Fig. 5

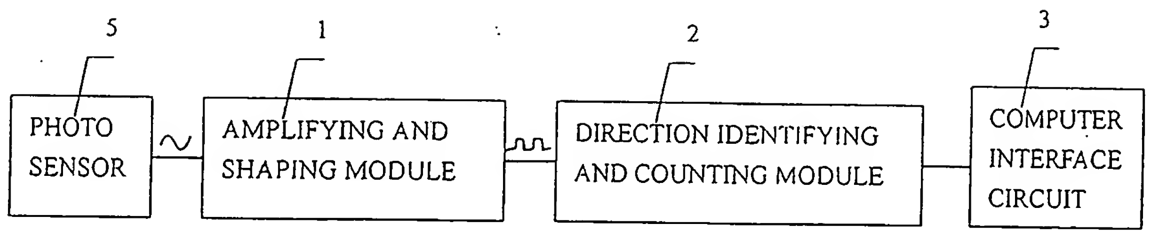
5
1
2
3
PHOTO SENSOR
AMPLIFYING AND SHAPING MODULE
DIRECTION IDENTIFYING AND COUNTING MODULE
COMPUTER INTERFACE CIRCUIT

Fig. 6

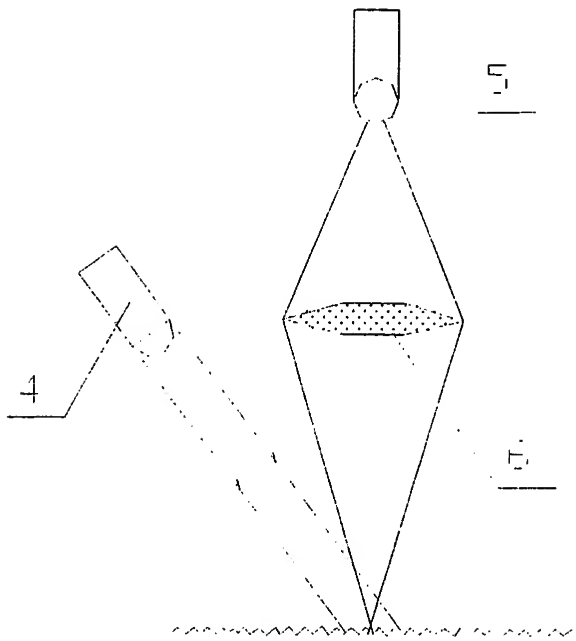

Fig. 7

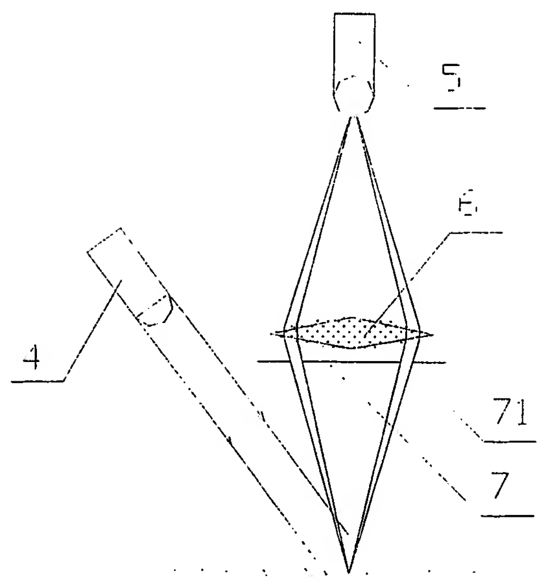

Fig. 8

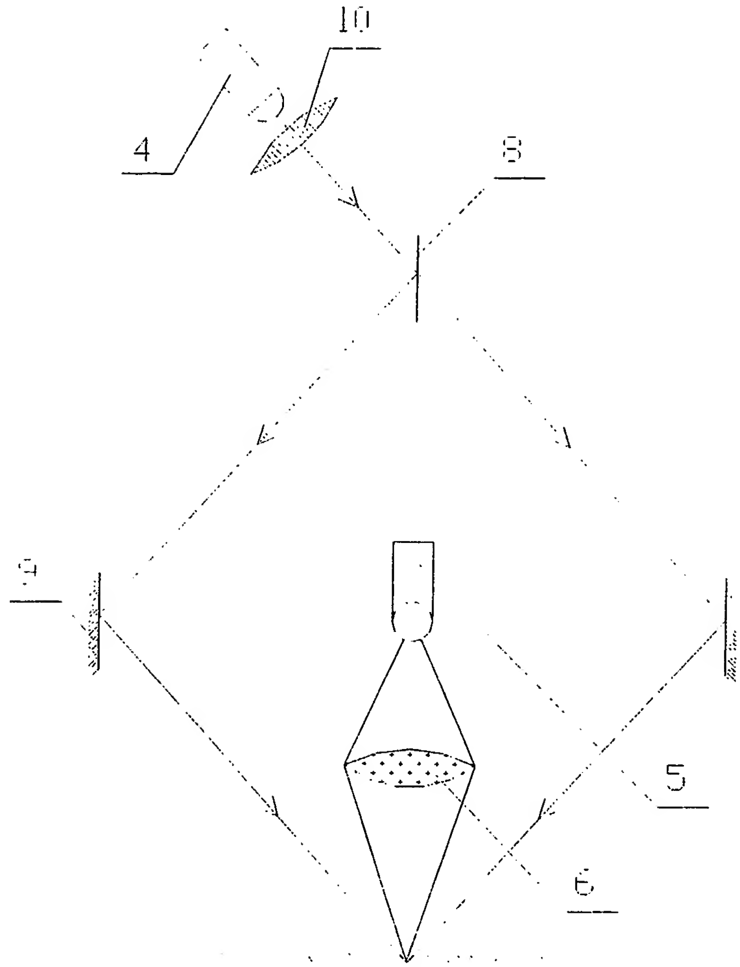

Fig. 9